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BioArray Solutions

# 2-D Array Assembly Using Light and Interfacial Patterning

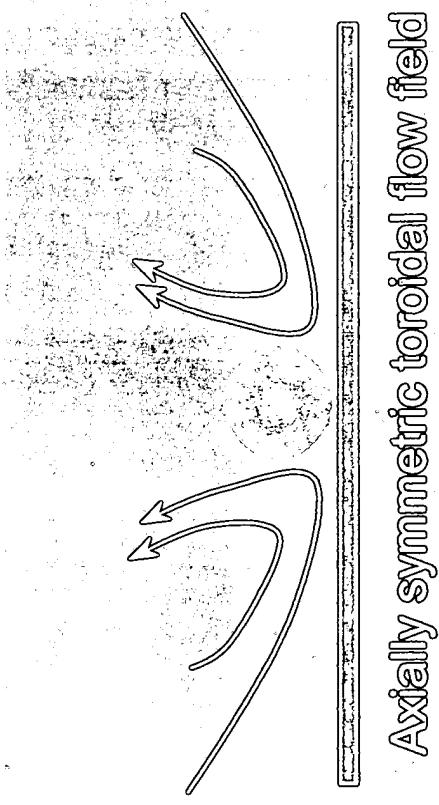
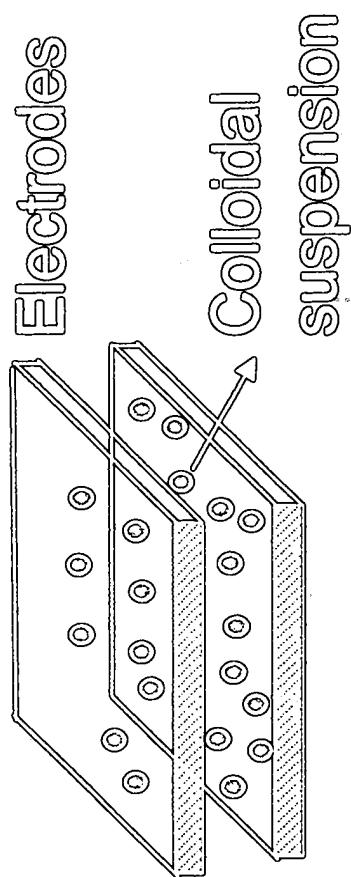
Michael Seul, Sukanta Bannerjee, Kairali Podual, Alice Li, Chiu Chau

BioArray Solutions

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Piscataway, NJ 08854  
[www.BioArrays.com](http://www.BioArrays.com)

03.05.01

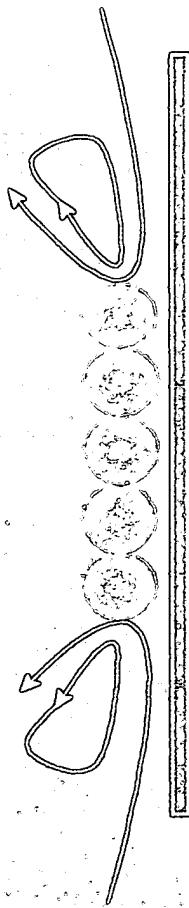
# Field Induced Crystallization



Axially symmetric toroidal flow field



2-D crystallization

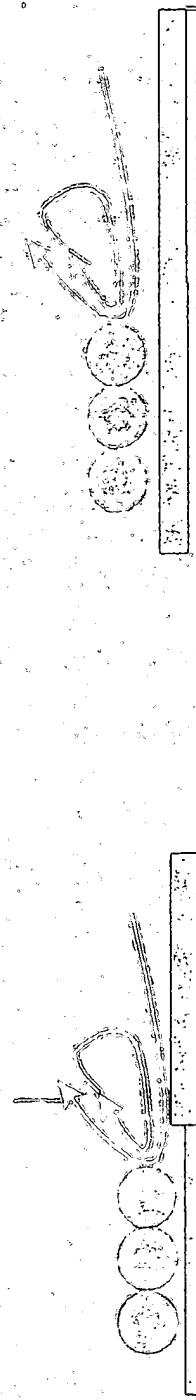
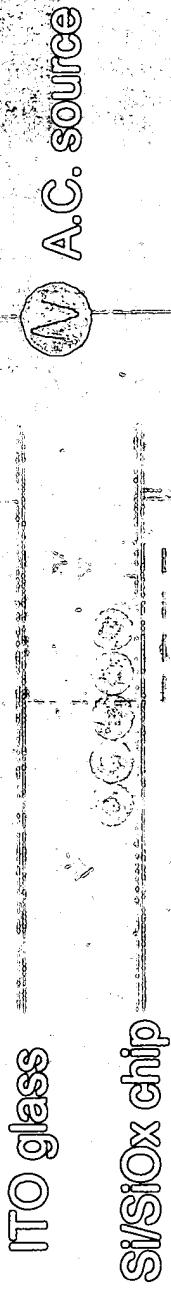


Yeh, S., Seul, M., and Shraiman, B.I.  
Nature, 386, 57-59 (1997)

Richetti, F., Prost, J., and Barois, P. J.  
Phys. Lett. 45, L1137-L1143 (1984)

LEAPS

## Light - Controlled Electrokinetic Assembly of Particles Near Surfaces



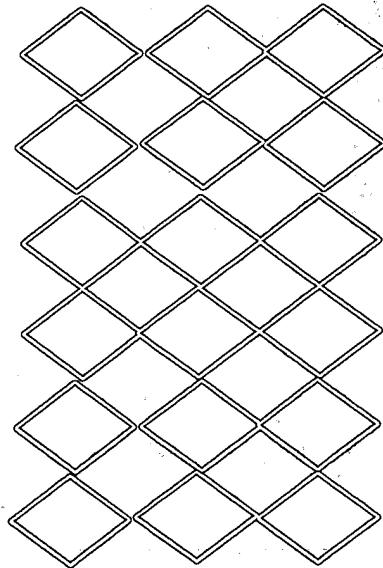
Interfacial Patterning

Light Patterning

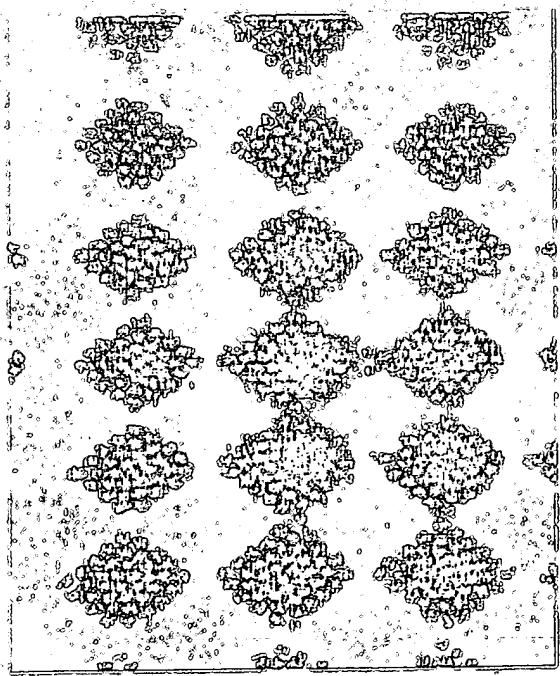
Seul, M. WO 97/40385

# Light Patterning

## Mask



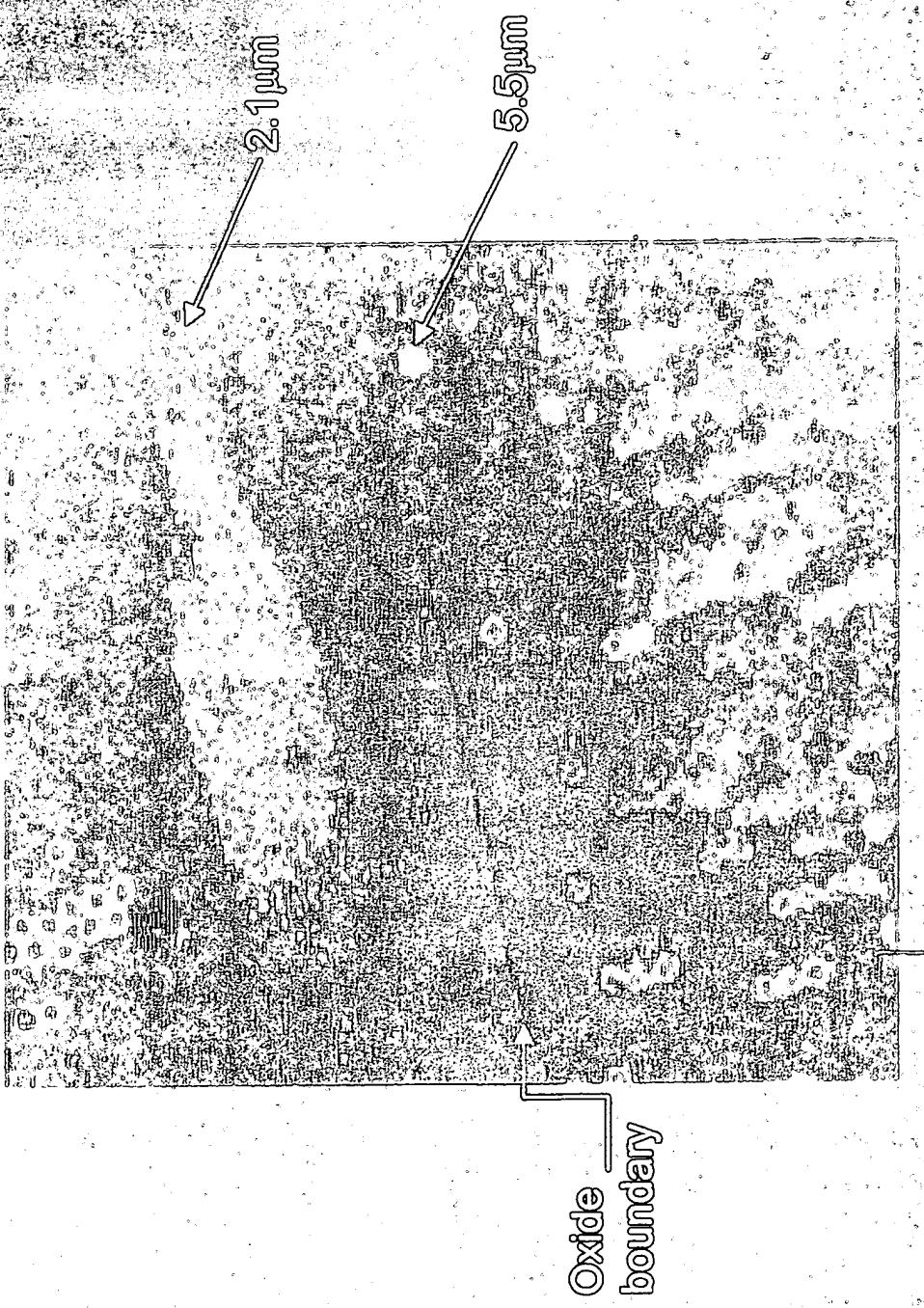
## Assembly



# Modeling of LEAPS

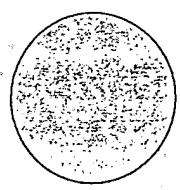
- Electrode-Insulator-Semiconductor (EIS) Interface
- Electric Field Distribution
- AC Electro Osmotic Flow (EOF)
- Bead Polarization
- Equation of Motion

# Sorting by Size

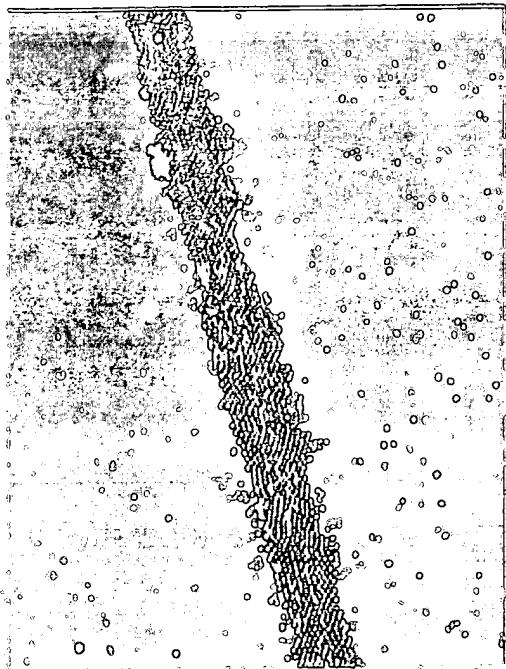
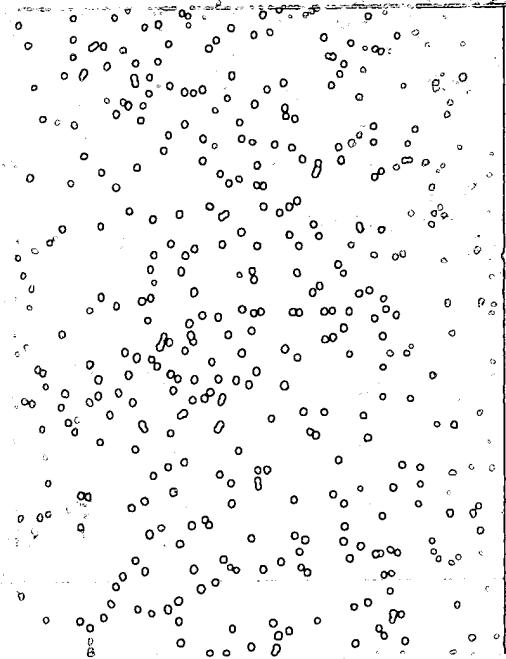
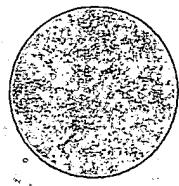


# Sorting by Polarizability

Carboxylated 5.5 $\mu$ m particle

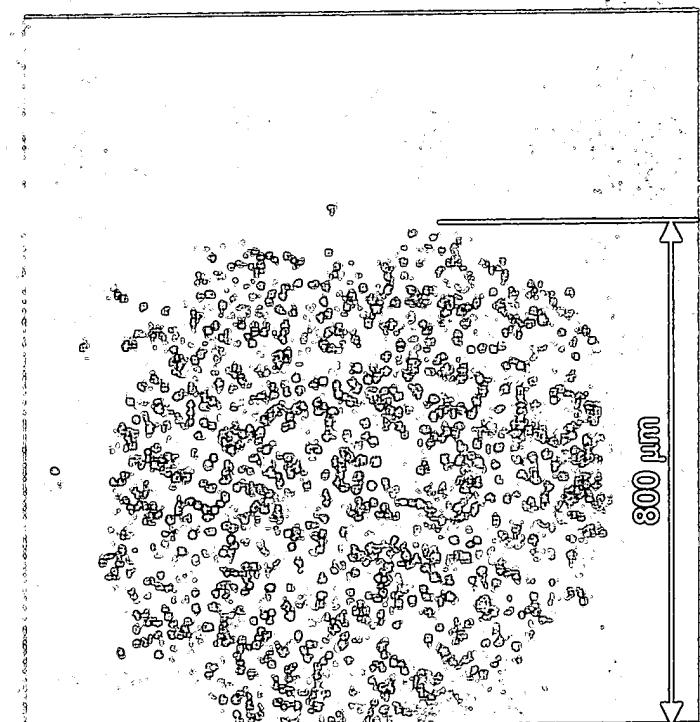


Protein conjugated 5.5 $\mu$ m particle



65 μm

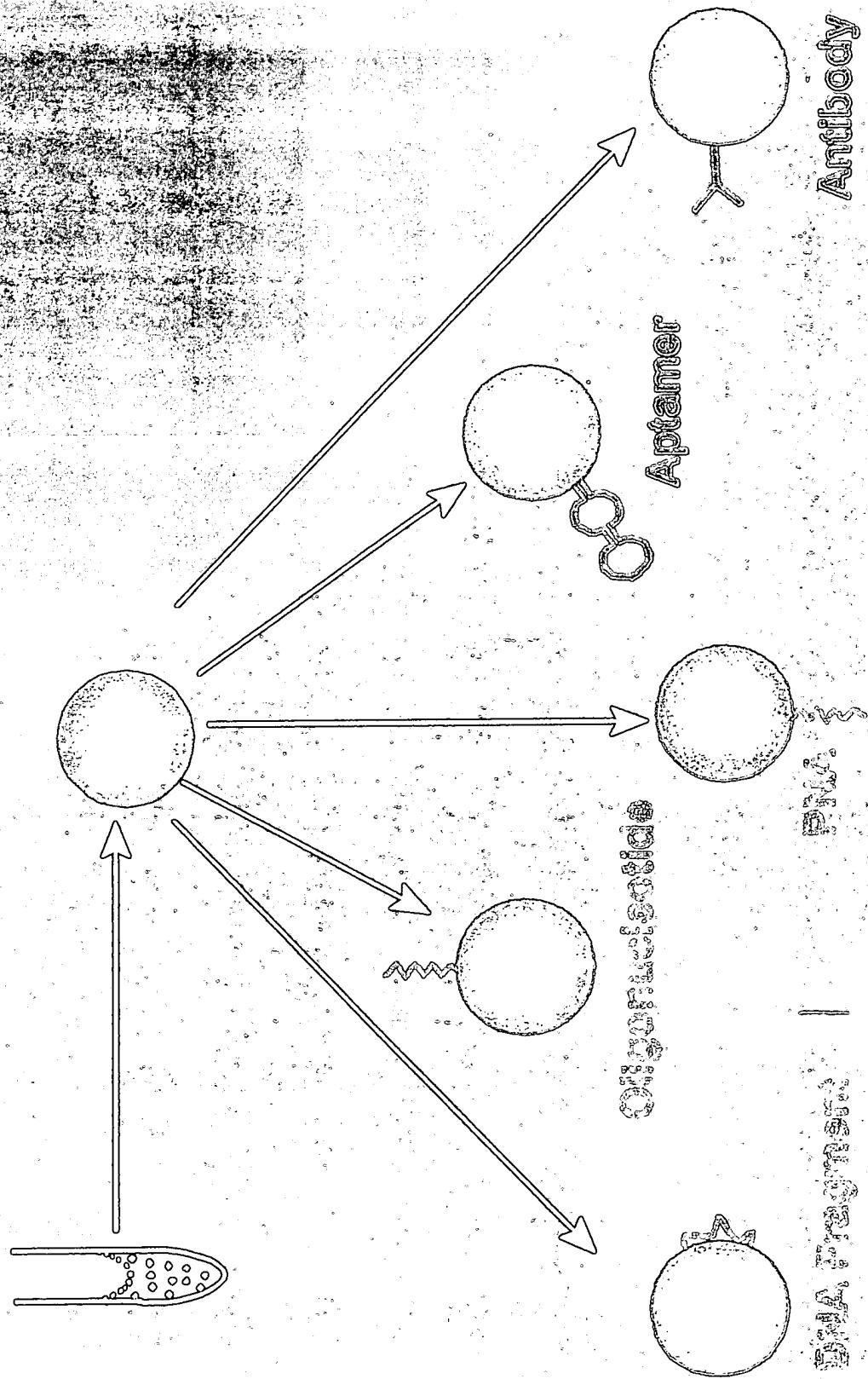
# Random Encoded Array Assembly



120 μm

# Functionalization

## Multifunctionality



READ

## Random Encoded Array Detection

Assay Image

Decoding Image

Probe A<sub>1</sub>

608

Probe A<sub>2</sub>

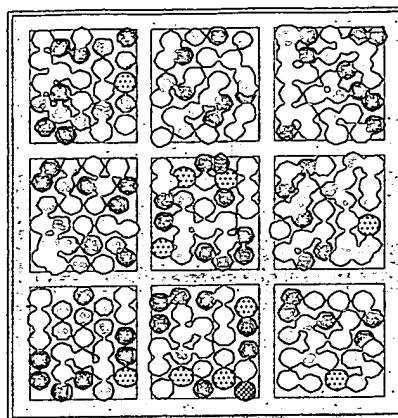
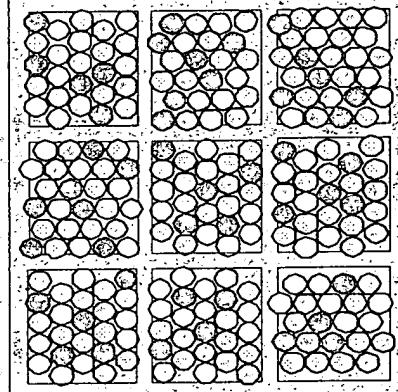
F508

Probe A<sub>3</sub>

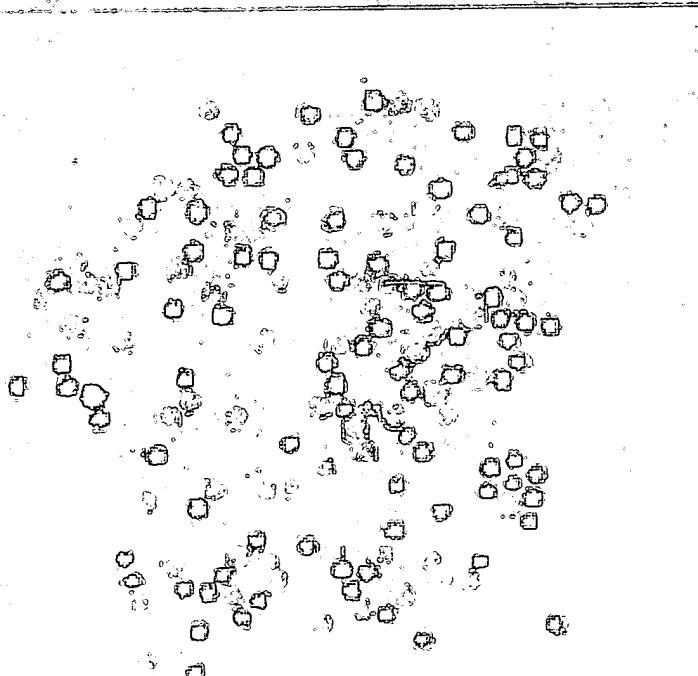
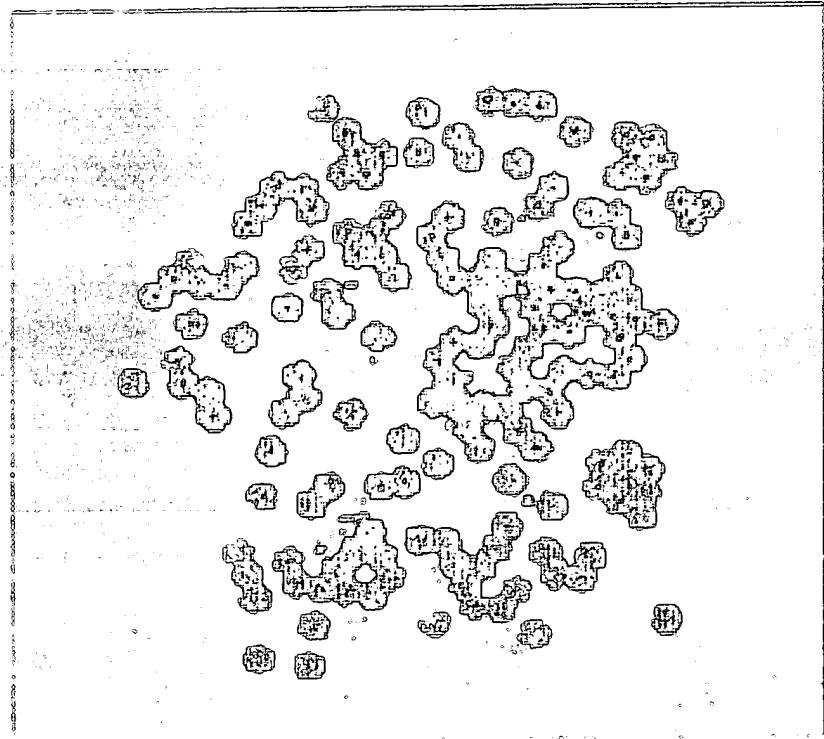
F517

TARGET

00000



BioArrayS



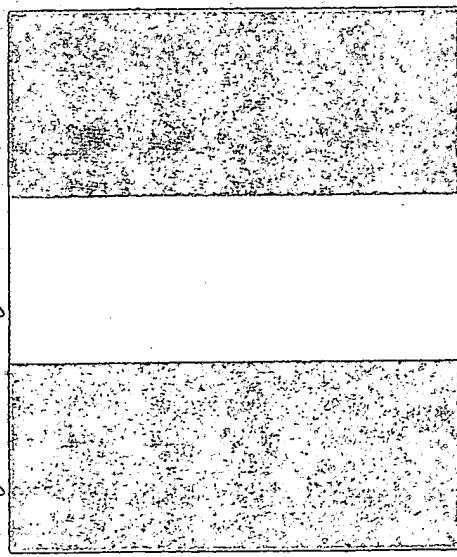
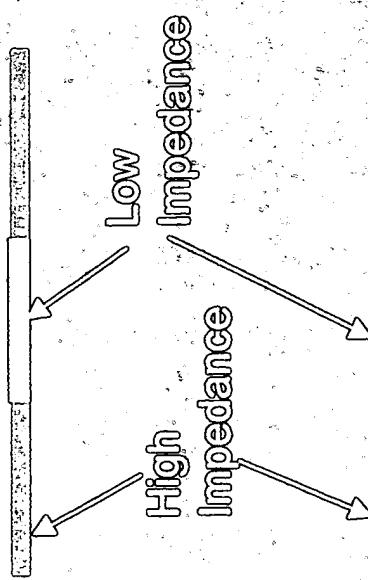
# LIGHT-GUIDED YEAST CELL ARRAYS



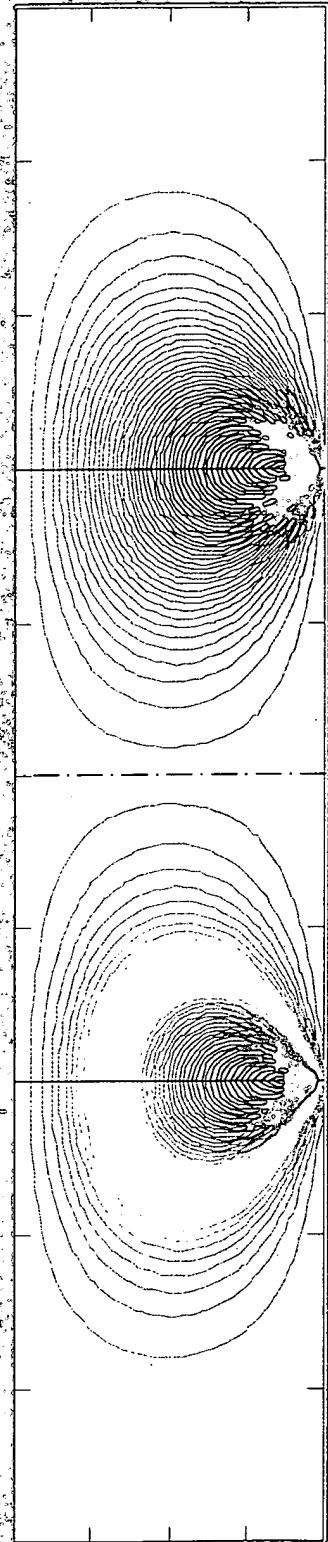
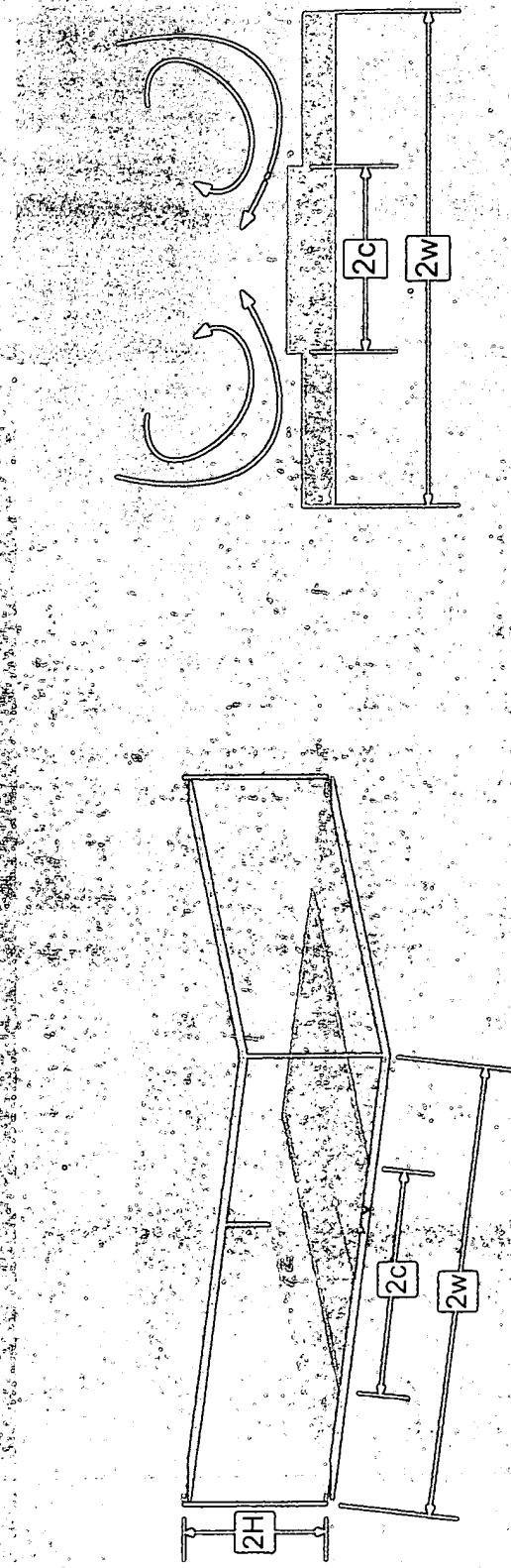
# Conclusions

- Optically programmable array assembly and reconfiguration
- Customized microparticle arrays
  - DNA chip
  - Protein chip
- Advanced on-chip Cellular Analysis

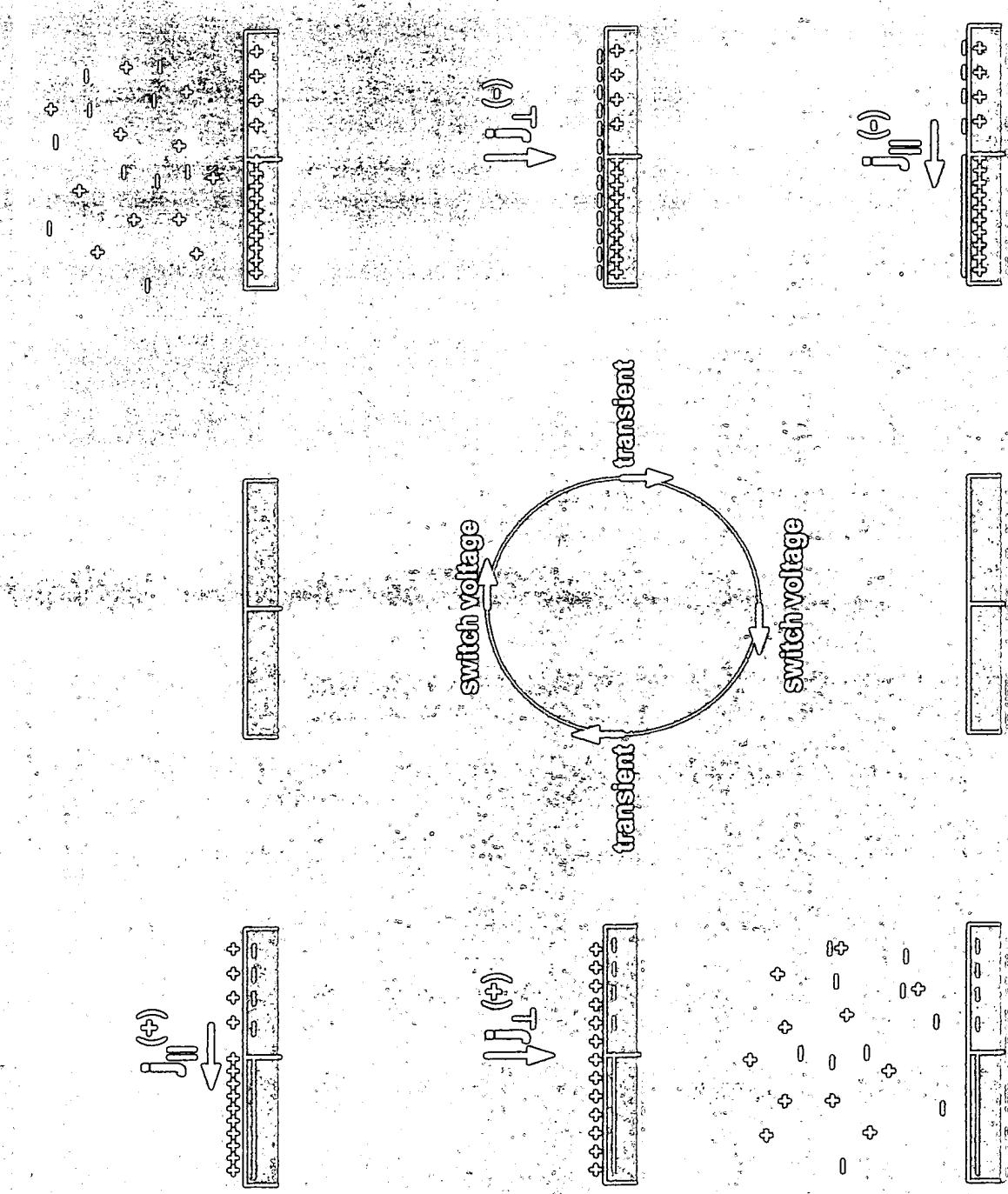
# Electric Field Near Surface



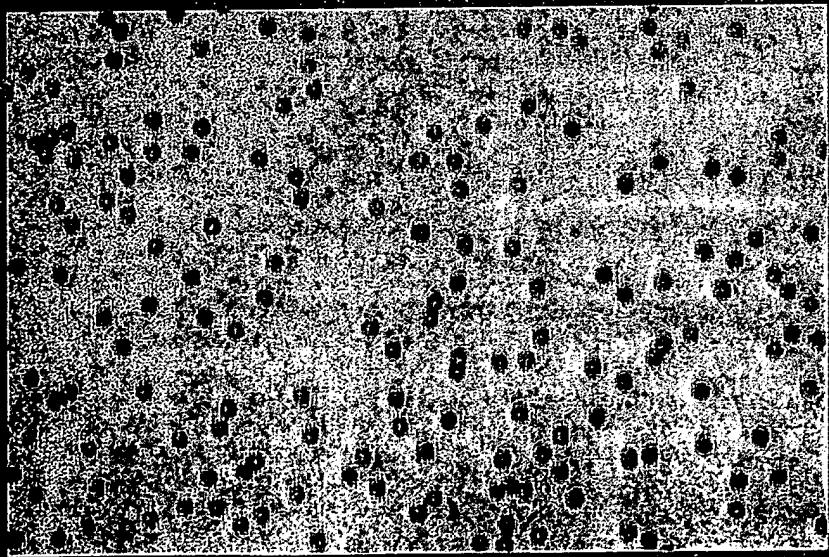
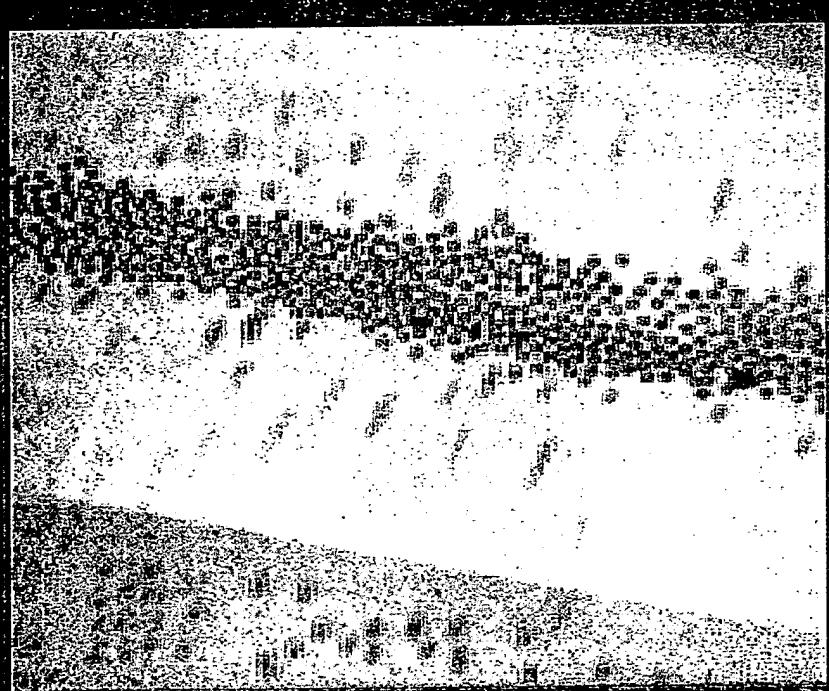
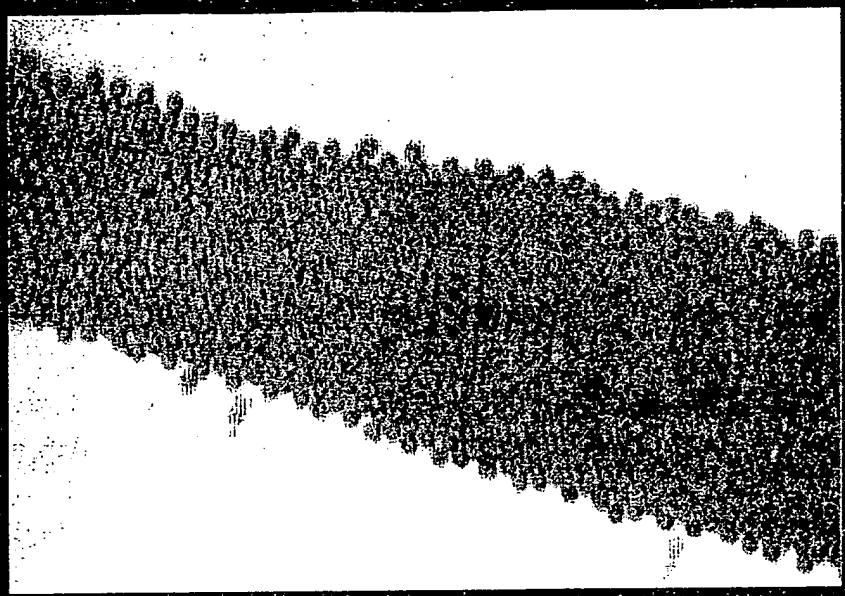
# Simulation of Fluid Flow in Slot Geometry



# Flow Rectification



# Array Assembly



# Beac Polarization

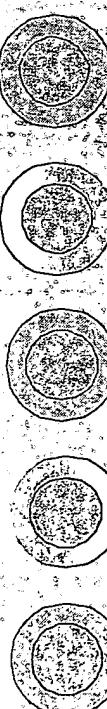
$$\omega = 0$$

$$\omega = \pi/2$$

$$\omega = \pi$$

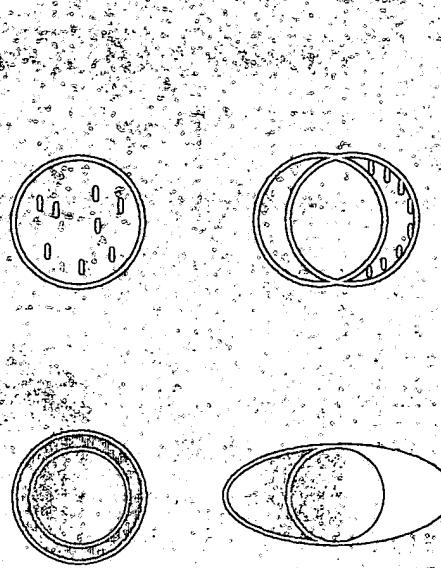
$$\omega = 3\pi/2$$

$$\omega = 2\pi$$



$$\omega = 0$$

$$B_{ax} = B_0 \sin(\omega t)$$



Frequency,  $\omega/\omega_0$

$$\frac{Dk^2}{(1+ak)^2} \equiv \frac{k^2}{(1+ak)^2} \frac{(k_B T / e)^2}{(k_B T / e)^2 + 2\epsilon_m^2}$$

$$\epsilon(\omega) = \epsilon_s(\omega) + \epsilon_m^2 / (\epsilon_s(\omega) + 2\epsilon_m^2)$$